

## Course Outcome: Choice Based Credit System

### B. Sc. Botany (Regular)

Semester	Paper Code	Paper Title	Course Outcome
TDC 1 <sup>st</sup> Semester	BOT-RC-1016	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	The "Biodiversity (Microbes, Algae, Fungi, and Archegoniate)" course (BOT-RC-1016) is a comprehensive study of various aspects of biodiversity within the microbial, algal, fungal, and archegoniate realms. This course comprises both theory and practical components. In the theoretical section, students will be able to explore the fascinating world of microorganisms, including viruses and bacteria, learning about their structure, replication, economic importance, and ecological roles. Algae, ranging from simple unicellular forms to complex multicellular species, are studied, emphasizing their classification, morphology, and ecological significance. The course also delves into the diverse world of fungi, including their classification, reproduction, and ecological roles. Additionally, students are introduced to archegoniate plants, emphasizing their transition to land and alternation of generations. The practical component of the course provides hands-on experience with microscopy and laboratory techniques. Students examine a variety of specimens, conduct Gram staining, and study the morphology and anatomy of microorganisms, algae, fungi, and archegoniate plants. This practical exposure helps students develop essential skills in specimen analysis and microscopy. Overall, this course will equip the students with a thorough understanding of biodiversity among these biological groups, laying a strong foundation for further studies in botany and related fields.
TDC 2 <sup>nd</sup> Semester	BOT-RC-2016	Plant Ecology and Taxonomy	The "Plant Ecology and Taxonomy" course (BOT-RC-2016) offers students a comprehensive understanding of plant ecology and taxonomy. This course consists of both theoretical and practical components. In the theoretical section, students are introduced to the fundamentals of plant ecology, covering ecological factors such as soil, water, light, and temperature. They learn about plant communities, ecotones, succession processes, and ecosystem structure, including energy flow, trophic organization, and

			<p>biogeochemical cycling. The course also explores phytogeography, focusing on biogeographical zones and endemism. Furthermore, students gain insights into plant taxonomy, starting with the basics of identification, classification, and nomenclature. They explore the role of herbaria and botanical gardens, documentation methods, and keys for plant identification. Taxonomic evidence from palynology, cytology, phytochemistry, and molecular data is discussed. Students learn about the taxonomic hierarchy, botanical nomenclature principles and rules, and classification types, including artificial, natural, and phylogenetic systems. In the practical component, students engage in hands-on activities related to plant ecology and taxonomy. They study instruments for measuring microclimatic variables, explore adaptations of hydrophytes and xerophytes, and conduct quantitative analyses of herbaceous vegetation. Additionally, students practice mounting dried and pressed plant specimens, gaining valuable experience in herbarium techniques. Overall, this course equips students with the knowledge and practical skills needed to understand plant ecology, taxonomy, and the relationships between plants and their environment.</p>
TDC 3 <sup>rd</sup> Semester	BOT-RC-3016	Plant Anatomy and Embryology	<p>The "Plant Anatomy and Embryology" course (BOT-RC-3016) provides students with an in-depth understanding of plant tissues, organs, and reproductive structures. This course consists of both theoretical and practical components. In the theoretical section, students learn about meristematic and permanent tissues, including root and shoot apical meristems, as well as simple and complex tissues. They will be able to explore the structure of dicot and monocot roots, stems, and leaves. The course covers secondary growth, focusing on the vascular cambium, its structure, and seasonal activity, along with the formation of heartwood and sapwood. Students gain insights into adaptive and protective systems, including the epidermis, cuticle, and stomata, with a general account of adaptations in xerophytes and hydrophytes. The structural organization of flowers, anthers, pollen, ovules, and embryo sacs is discussed, along with the mechanisms of pollination, double fertilization, seed structure, appendages, and dispersal mechanisms. The</p>

			course also covers embryo and endosperm types, structure, and functions, as well as apomixis and polyembryony. In the practical component, students engage in hands-on activities related to plant anatomy and embryology. They will study meristems, tissues (parenchyma, collenchyma, and sclerenchyma), stem and root anatomy in monocots and dicots, leaf structure, adaptive anatomy in xerophytes and hydrophytes, and the structure of anthers, tapetum, ovules, female gametophytes, and embryo/endosperm. Students will also be able to explore pollination types and seed dispersal mechanisms, including various appendages. Overall, this course will equip the students with the knowledge and practical skills needed to understand plant anatomy, reproductive structures, and their adaptations.
TDC 4 <sup>th</sup> Semester	BOT-RC-4016	Plant Physiology and Metabolism	"Plant Physiology and Metabolism" (BOT-RC-4016) is a comprehensive course that explores key plant physiological processes. Students learn about plant-water relations, mineral nutrition, phloem translocation, photosynthesis, respiration, enzymes, nitrogen metabolism, and plant growth regulators. Additionally, the course covers plant responses to light and temperature. The practical component involves hands-on experiments such as osmotic potential determination, transpiration studies, stomatal index calculations, enzyme activity investigations, and photosynthesis experiments. Demonstrations cover topics like bolting and auxin-induced rooting. This course provides students with a deep understanding of how plants function and adapt to their environment, serving as a strong foundation for advanced studies in plant biology and ecology.
Discipline Specific Elective Papers			
TDC 5 <sup>th</sup> Semester	BOT-RE-5016	Cell and Molecular Biology	"Cell and Molecular Biology" (BOT-RE-5016) is a comprehensive course covering cellular and molecular processes. The theory component encompasses biology techniques, cell fundamentals, organelles, membranes, cell cycles, genetic material, transcription, and gene expression regulation. The practical component involves hands-on experiments and microscopy studies, including cell size measurement, mitosis and meiosis, plasmolysis, DNA packaging, and karyotyping. This course equips students with a

			strong foundation in cell and molecular biology, preparing them for advanced studies and research.
TDC 5 <sup>th</sup> Semester	BOT-RE-5026	Economic Botany and Biotechnology	It is a comprehensive course that delves into economically vital plants, exploring their origins, characteristics, and practical uses. It also introduces biotechnology fundamentals. Key topics include crop origins, morphology, and applications, spanning cereals like wheat, legumes like gram and soybean, and spices like clove and black pepper. The course covers beverages like tea, oil-yielding plants with a focus on groundnut, fiber-yielding plants such as cotton, and plant tissue culture techniques. Additionally, it delves into advanced biotechnological tools, including DNA fingerprinting, PCR, and molecular diagnosis. Practical components involve hands-on activities, providing students with essential skills for careers in plant science and biotechnology.
TDC 5 <sup>th</sup> Semester	BOT-RE-5036	Genetics and Plant Breeding	In the course "Genetics and Plant Breeding" (BOT-RE-5036), students will embark on a comprehensive journey through the fascinating world of genetics and its pivotal role in plant biology. Over 60 lectures, they will delve into the historical origins of genetics, learning about Gregor Mendel's groundbreaking work. Students will gain a profound understanding of essential genetic terminologies, Mendelian laws, and how they apply to various inheritance patterns. Through extensive coursework, they will become proficient in calculating modified Mendelian ratios, employing chi-square analysis, and conducting pedigree evaluations. They will explore diverse topics, from cytoplasmic inheritance to the chromosome theory of inheritance. Additionally, they will unravel the mysteries of sex determination, sex-linked inheritance, linkage, and crossing over. The course will not only cover the theoretical aspects of genetics but also delve into its practical applications in plant breeding. Students will grasp the objectives and methodologies of crop improvement, including the role of mutations, polyploidy, and biotechnology. Practical skills will be honed through hands-on exercises in Mendelian genetics, chromosome mapping, and the analysis of aneuploidy. By course completion, students will be well-equipped to apply their genetic knowledge to real-world

			scenarios, making informed decisions in plant breeding and research.
TDC 6 <sup>th</sup> Semester	BOT-RE-6016	Analytical Techniques in Plant Sciences	<p>Upon successful completion of the BOT-RE-6016 course on Analytical Techniques in Plant Sciences, the students will have a basic understanding of Microscopy, where the students will be able to comprehend the principles and applications of microscopy techniques, including light microscopy, fluorescence microscopy, confocal microscopy, and electron microscopy. They will be able to utilize fluorochromes for various applications, such as chromosome banding and FISH. The students will get clear understanding of cell fractionation techniques, including centrifugation, sucrose density gradient, CsCl<sub>2</sub> gradient, analytical centrifugation, and ultracentrifugation. They will effectively identify and use marker enzymes. They will be able to grasp the use of radioisotopes in biological research and apply this knowledge in auto-radiography and pulse-chase experiments, spectrophotometry principles to analyze biological samples in research effectively. The students will also be able to understand the principles of chromatography and proficiently apply various chromatographic techniques, including paper chromatography, column chromatography, TLC, GLC, HPLC, ion-exchange chromatography, molecular sieve chromatography, and affinity chromatography, mass spectrometry, X-ray diffraction, and X-ray crystallography techniques for characterizing proteins and nucleic acids. They will perform electrophoresis methods, including AGE, PAGE, and SDS-PAGE, statistical methods to analyze and interpret biological data. They will understand data representation, measures of central tendency, measures of dispersion, and perform chi-square tests for goodness of fit, demonstrate proficiency in various practical techniques, including blotting techniques (Southern, Northern, and Western), DNA fingerprinting, DNA sequencing, PCR, ELISA, thin-layer chromatography, chloroplast isolation, pigment separation, protein concentration estimation, and separation of DNA and proteins using PAGE and AGE.</p> <p>This will enable the students to apply the learned analytical techniques to address real-world problems and challenges in plant sciences,</p>

			including plant genetics, physiology, and biotechnology. By the course's conclusion, students will possess a strong foundation in analytical techniques relevant to plant sciences, equipping them to contribute effectively to research and development in this field.
TDC 6 <sup>th</sup> Semester	BOT-RE-6026	Dissertation	The "Project Work/Dissertation" course (BOT-RE-6026) is a vital component of the academic curriculum, providing students with a platform to conduct independent research in the field of botany. During this course, students select a specific research topic within botany, review relevant literature, design and execute experiments or data collection, analyze findings, and document their research in a comprehensive report. The key objectives include fostering research skills, critical thinking, and problem-solving abilities in students. They learn to apply theoretical knowledge to practical scenarios and contribute to the advancement of botanical science. Presentation and communication skills are honed as students often present their findings to peers or faculty. Ultimately, this course empowers students to engage in original research, make meaningful contributions to the field, and prepare for future careers in academia, research institutions, or industries related to botany and environmental science. Successful completion of a dissertation demonstrates a student's proficiency in scientific research and is a significant component of their academic evaluation.
<b>Skill Enhancement Papers</b>			
TDC 3 <sup>rd</sup> Semester	BOT-SE-3014	Biofertilizers	Upon successful completion of the Biofertilizers course, students will gain comprehensive knowledge of various microorganisms used as biofertilizers, including <i>Rhizobium</i> , <i>Azospirillum</i> , <i>Azotobacter</i> , cyanobacteria (blue-green algae), and mycorrhizal associations. They will understand the isolation, identification, and mass multiplication techniques for these biofertilizers. Students will analyze crop responses to biofertilizer inoculation, with a specific focus on <i>Azotobacter's</i> impact on agricultural productivity. They will appreciate the role of biofertilizers in sustainable agriculture, particularly in nitrogen fixation, phosphorus nutrition, and enhancing crop growth and yield through cyanobacteria, <i>Azolla</i> , and mycorrhizal associations. Furthermore, the

			learners will grasp organic farming techniques, such as green manuring, organic fertilizers, biocompost making, and vermicomposting, for environmentally friendly agriculture. And at last, they will be prepared for practical field applications, promoting soil health and sustainable crop production. This course will empower students to contribute to sustainable agricultural practices and environmentally conscious farming.
TDC 4 <sup>th</sup> Semester	BOT-SE-4014	Nursery and Gardening	<p>Upon completing the Nursery and Gardening course, students will achieve a comprehensive set of skills and knowledge in horticultural practices. They will first understand the fundamentals of nursery management, including its objectives and the infrastructure needed for successful operations. Students will gain insights into seed science, learning about seed structures, dormancy, and storage techniques, as well as the importance of seed testing and certification in quality assurance. The course will also provide students with expertise in vegetative propagation methods such as air-layering and cutting, along with the crucial aspects of hardening and the role of specialized structures like greenhouses. They will be able to explore the art of gardening and landscaping, covering everything from design principles to practical operations like soil preparation, fertilization, irrigation, and pest management. Moreover, the course will offer hands-on experience in cultivating various vegetables and guide students through seed selection, sowing, transplanting, and harvesting. It will also address the essential aspects of storage and marketing procedures for vegetable produce.</p> <p>Overall, this course will equip the students with the practical skills and theoretical knowledge needed for successful nursery and gardening practices, making them well-prepared for careers in horticulture, agriculture, landscaping, and related fields. They will contribute to creating sustainable and aesthetically pleasing environments.</p>
TDC 5 <sup>th</sup> Semester	BOT-SE-5024	Plant Diversity and Human Welfare	The course in Plant Diversity and Human Welfare, designated as BOT-SE-5024, offers students a comprehensive understanding of the critical relationship between plant diversity and human well-being. By the end of this course, students will achieve several key outcomes. They

			<p>will acquire an in-depth comprehension of the various dimensions of plant diversity, including genetic, species, and ecosystem diversity. Additionally, students will grasp the multifaceted values of biodiversity, such as ethical and aesthetic considerations, as well as the precautionary principle. They will become proficient in methodologies for evaluating biodiversity and comprehending the diverse uses of plants and microbes. Furthermore, the students will be able to analyze the detrimental factors leading to biodiversity loss, including genetic and species diversity. They will also gain insights into conservation strategies, both in situ and ex situ, and recognize the societal aspects associated with conservation efforts. Lastly, the course will equip students with a profound appreciation of forestry, plant utilization, and sustainable practices, encompassing avenue trees, ornamental plants, alcoholic beverages, fruits, nuts, and wood. This knowledge will enable students to contribute effectively to biodiversity preservation and sustainable human development.</p>
TDC 6 <sup>th</sup> Semester	BOT-SE-6024	Mushroom Culture Techniques	<p>The BOT-SE-6024 course on Mushroom Culture Technology is designed to impart a comprehensive understanding of mushroom cultivation and its applications. Upon completing this course, students will achieve several significant learning outcomes. Firstly, students will grasp the historical context and nutritional significance of edible mushrooms, including the ability to distinguish between edible and poisonous varieties. The course delves into the cultivation techniques for key edible mushrooms like <i>Pleurotus sajor-caju</i>, <i>P. ostreatus</i> etc., prevalent in India. The students will gain practical expertise in mushroom cultivation technology, covering infrastructure setup, substrate selection, sterilization, spawn preparation, and bed formation. The curriculum emphasizes sustainable and cost-effective methods for mushroom production, including composting technology. Furthermore, students will learn about mushroom storage methods, nutritional value, and food preparation. They will also gain insights into research centers and understand the economic aspects, such as cost-benefit analysis, marketing, and export potential, associated with mushroom cultivation. In</p>

			summary, this course will equip the students with the knowledge and skills to engage in edible mushroom cultivation, preservation, and utilization, contributing to both personal consumption and commercial ventures in agriculture and nutrition.
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